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| APPLICATION NO.  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.    | CONFIRMATION NO. |
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| 10/685,659   | 10/14/2003  | Ming Fang            | 10559-860001           | 5642             |
| 20985  | 7590        | 02/12/2007           |                        |                  |
| FISH & RICHARDSON, PC<br>P.O. BOX 1022<br>MINNEAPOLIS, MN 55440-1022 |             |                      | EXAMINER<br>WONG, EDNA |                  |
|  |             |                      | ART UNIT               | PAPER NUMBER     |
|  |             |                      | 1753                   |                  |

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE  | DELIVERY MODE |
|--|------------|---------------|
| 3 MONTHS                               | 02/12/2007 | PAPER         |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

**Office Action Summary**

Application No.

10/685,659

Applicant(s)

FANG ET AL.

Examiner

Edna Wong

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 23 January 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) 1-20 and 30-34 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 21-29 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date January 20, 2004.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_.

***Election/Restrictions***

Applicant's election with traverse of Group **III**, claims **21-29**, in the reply filed on January 23, 2007 is acknowledged. The traversal is on the ground(s) that Groups III and IV do not have different classifications. Moreover, should claims 21, 24, and 25 be rejected, simultaneous examination of claims 26 and 30 would not appear to present any undue burden. This is not found persuasive because while Group III and IV have the same classification, they do not have the same search. There would be a serious burden on the examiner if restriction is not required because Group III and IV have a different field of search.

The requirement is still deemed proper and is therefore made FINAL.

Accordingly, claims **1-20 and 30-34** are withdrawn from consideration as being directed to a non-elected invention.

***Claim Rejections - 35 USC § 112***

Claims **22-23 and 25-26** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

**Claim 22**

lines 2-3, "the current density greater than approximately 40 mA/cm<sup>2</sup>" lacks antecedent basis.

lines 2-3, it appears that “the current density greater than approximately 40 mA/cm<sup>2</sup>” is further limiting the current density greater than approximately 30 mA/cm<sup>2</sup> as recited in claim 21, lines 2-3. However, it is unclear if it is. If it is not, then what is the relationship between the current density greater than approximately 40 mA/cm<sup>2</sup> and the current density greater than approximately 30 mA/cm<sup>2</sup>?

#### Claim 23

lines 1-2, it appears that “wherein electroplating the tin comprises ...” is further limiting the electroplating the tin comprises as recited in claim 22, lines 1-2. However, it is unclear if it is. If it is, then it is suggested that the word -- further -- be inserted before the word “comprises”. Otherwise, the electroplating of the tin has two separate, independent definitions.

lines 2-3, “the current density greater than approximately 50 mA/cm<sup>2</sup>” lacks antecedent basis.

lines 2-3, it appears that “the current density greater than approximately 50 mA/cm<sup>2</sup>” is further limiting the current density greater than approximately 40 mA/cm<sup>2</sup> as recited in claim 22, lines 2-3. However, it is unclear if it is. If it is not, then what is the relationship between the current density greater than approximately 40 mA/cm<sup>2</sup> and the current density greater than approximately 50 mA/cm<sup>2</sup>?

Claim 25

lines 1-2, it appears that “wherein electroplating the tin comprises ...” is further limiting the electroplating the tin comprises as recited in claim 24, lines 1-2. However, it is unclear if it is. If it is, then it is suggested that the word -- further -- be inserted before the word “comprises”. Otherwise, the electroplating of the tin has two separate, independent definitions.

lines 2-9, “the solution including one or more stannous alkane sulfonates of the formula  $(\text{RSO}_3)_2\text{Sn}$ , one or more of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid, and a mixture thereof, and the sulfopropylated anionic surfactant having a polymeric hydrophilic portion” lacks antecedent basis.

lines 2-3, it appears that the “the solution including one or more stannous alkane sulfonates of the formula  $(\text{RSO}_3)_2\text{Sn}$ , one or more of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid, and a mixture thereof, and the sulfopropylated anionic surfactant having a polymeric hydrophilic portion” is further limiting the solution recited in claim 24, lines 2-5. However, it is unclear if it is. If it is then, it is suggested that the word -- further -- be inserted after the word “solution”.

lines 4-5, it appears that the “one or more stannous alkane sulfonates of the formula  $(\text{RSO}_3)_2\text{Sn}$ ” is further limiting the bath-soluble tin compound recited in claim 24,

Art Unit: 1753

line 3. However, it is unclear if it is. If it is not, then what is the relationship between the one or more stannous alkane sulfonates of the formula  $(\text{RSO}_3)_2\text{Sn}$  and the bath-soluble tin compound?

line 5, the definition of "R" in the formula  $(\text{RSO}_3)_2\text{Sn}$  is missing in the claim.

lines 6-7, it appears that the "one or more of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid, and a mixture thereof" is further limiting the strong acid recited in claim 24, line 4. However, it is unclear if it is. If it is not, then what is the relationship between the one or more of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid, and a mixture thereof and the strong acid?

lines 6-7, recites "**one** or more of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid, **and** a mixture thereof". If one of the species was selected, how can the Markush group also include the specie of "and a mixture thereof"? The scope of the claim is indefinite.

lines 6-7, what is the difference between the specie of "one or **more** of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid" and "**mixture thereof**"?

lines 8-9, "the sulfopropylated anionic surfactant having a polymeric hydrophilic

portion" lacks antecedent basis.

lines 8-9, it appears that "the sulfopropylated anionic surfactant having a polymeric hydrophilic portion" is further limiting the sulfopropylated anionic surfactant recited in claim 24, line 5. However, it is unclear if it is. If it is not, then what is the relationship between the sulfopropylated anionic surfactant having a polymeric hydrophilic portion and the sulfopropylated anionic surfactant?

Claim 26

lines 1-2, it appears that "wherein electroplating the tin comprises ..." is further limiting the electroplating the tin comprises as recited in claim 25, lines 1-2. However, it is unclear if it is. If it is, then it is suggested that the word -- further -- be inserted before the word "comprises". Otherwise, the electroplating of the tin has two separate, independent definitions.

lines 2-11, "the solution including between approximately 20 and 40 grams per liter of one or more of stannous methane sulfonate, stannous sulfate, and a mixture thereof, between approximately 100 and 200 grams per liter of one of methanesulfonic acid, sulfuric acid, and a mixture thereof, and between approximately 1 and 2 grams of one or more polyethyleneglycol alkyl-3-sulfopropyl diethers per liter" lacks antecedent basis.

lines 2-11, it appears that “the solution including between approximately 20 and 40 grams per liter of one or more of stannous methane sulfonate, stannous sulfate, and a mixture thereof, between approximately 100 and 200 grams per liter of one of methanesulfonic acid, sulfuric acid, and a mixture thereof, and between approximately 1 and 2 grams of one or more polyethyleneglycol alkyl-3-sulfopropyl diethers per liter” is further limiting the solution recited in claim 25, lines 2-9. However, it is unclear if it is. If it is then, it is suggested that the word -- further -- be inserted after the word “solution”.

lines 4-5, recites “**one** or more of a stannous methane sulfonate, stannous sulfate, **and** a mixture thereof”. If one of the species was selected, how can the Markush group also include the species of “and a mixture thereof”? The scope of the claim is indefinite.

lines 4-5, what is the difference between the species of “one or **more** of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid” and “**mixture thereof**”?

line 5, it appears that the “stannous methane sulfonate” is further limiting the one or more stannous alkane sulfonates of the formula  $(\text{RSO}_3)_2\text{Sn}$  as recited in claim 25, lines 4-5. However, it is unclear if it is. If it is not, then what is the relationship between the stannous methane sulfonate and the one or more stannous alkane sulfonates of the formula  $(\text{RSO}_3)_2\text{Sn}$ ?



Art Unit: 1753

lines 8-9, it appears that the “one of methanesulfonic acid, sulfuric acid, and a mixture thereof” is further limiting the one or more of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid, and a mixture thereof” as recited in claim 25, lines 6-7. However, it is unclear if it is. If it is not, then what is the relationship between the one of methanesulfonic acid, sulfuric acid, and a mixture thereof and the one or more of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid, and a mixture thereof?

lines 7-9, recites “**one** or more of methanesulfonic acid, sulfuric acid, **and** a mixture thereof”. If one of the species was selected, how can the Markush group also include the specie of “and a mixture thereof”? The scope of the claim is indefinite.

lines 7-9, what is the difference between the specie of “one or **more** of methanesulfonic acid, sulfuric acid” and “**mixture thereof**”?

line 8, it appears that the “sulfuric acid” is the same as that recited in claim 25, line 6. However, it is unclear if it is.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

Art Unit: 1753

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

I. Claims **21-23 and 29** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Brown et al.** (US Patent No. 6,322,686 B1).

Brown teaches a method comprising:

electroplating tin (col. 6, lines 27-34) with a current density (= in the range of 50 to 2000 ASF or higher) [col. 7, lines 19-22].

Electroplating the tin comprises electroplating the tin from a solution including a bath-soluble tin compound (col. 3, lines 18-31), a strong acid (col. 3, lines 50-63), and a surfactant (= wetting agents) [col. 5, lines 31, 57 and 62-66].

Electroplating the tin comprises electroplating the tin from the solution including one or more stannous alkane sulfonates of the formula  $(\text{RSO}_3)_2\text{Sn}$  (= tin alkane sulfonate) [col. 3, line 20-21]; and one or more of a sulfuric acid, an alkane sulfonic acid, an alkanol sulfonic acid, and a mixture thereof (alkane sulfonic acid) [col. 3, lines 53-54].

Electroplating the tin comprises electroplating the tin from the solution including between approximately 20 and 40 grams per liter (= 5 to 100 g/L) [col. 3, lines 33-36] of one of stannous methane sulfonate, stannous sulfate, and a mixture thereof (= tin sulfates and tin methane sulfonate) [col. 3, lines 20-21]; and between approximately 100 and 200 grams per liter (= 10 to 400 g/L) [col. 3, line 66-67] of one of methanesulfonic acid, sulfuric acid, and a mixture thereof (= methane sulfonic acid) [col. 3, line 54].

The method of Brown differs from the instant invention because Brown does not disclose the following:

a. Wherein the current density is greater than approximately 30 mA/cm<sup>2</sup>, as recited in claim 21.

b. Wherein electroplating the tin comprises electroplating the tin with the current density greater than approximately 40 mA/cm<sup>2</sup>, as recited in claim 22.

c. Wherein electroplating the tin comprises electroplating the tin with the current density greater than approximately 50 mA/cm<sup>2</sup>, as recited in claim 23.

Brown teaches that typical current densities are in the range of 50 to 2000 ASF **or higher** (col. 7, lines 19-22).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the current density described by Brown with wherein the current density is greater than approximately 30 mA/cm<sup>2</sup>, approximately 40 mA/cm<sup>2</sup> and approximately 50 mA/cm<sup>2</sup> because tin may be successfully deposited using current densities higher than 2000 ASF as taught by Brown (col. 7, lines 19-22).

Changes in the current density is not a patentable modification; however, such changes may impart patentability to a process if the ranges claimed produce new and unexpected results which are different in kind and not merely in degree from results of the prior art, such ranges are termed "critical" ranges and Applicant has the burden of proving such criticality; even though Applicant's modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within capabilities of one skilled in the art; more particularly, where general conditions of the claim are disclosed in the prior art, it is not inventive to discover

optimum or workable ranges by routine experimentation (MPEP § 2144.05).

d. Wherein a plating efficiency is greater than approximately 95%, as recited in claim 21.

Brown teaches electroplating tin (col. 6, lines 27-34). The electroplating would have naturally had a plating efficiency.

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because Brown discloses a method at least in a similar manner as instantly claimed. There does not appear to be any method limitations set forth in the instant claims to distinguish the instant claims from the prior art. Therefore, it would have been well within one having ordinary skill in the art to expect that the electroplating disclosed by Brown would have had a plating efficiency that is greater than approximately 95%, unless proven otherwise.

e. Wherein electroplating the tin comprises forming a tin deposit that is greater than 99% tin, as recited in claim 29.

Brown teaches electroplating tin (col. 6, lines 27-34).

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because Brown discloses a method at least in a similar manner as instantly claimed. There does not appear to be any method limitations set forth in the instant claims to distinguish the instant claims from the prior

Art Unit: 1753

art. Therefore, it would have been well within one having ordinary skill in the art to expect that the electroplating disclosed by Brown would have formed a tin deposit that is greater than 99% tin:

Furthermore, the tin that is deposited is not an alloy.

II. Claims **24-26** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Brown et al.** (US Patent No. 6,322,686 B1) as applied to claims 21-23 and 29 above, and further in view of **Kurze et al.** (US Patent No. 4,820,388).

Brown is as applied above and incorporated herein.

The method of Brown differs from the instant invention because Brown does not disclose the following:

- a. Wherein the surfactant is a sulfopropylated anionic surfactant, as recited in claim 24.
- b. Wherein the sulfopropylated anionic surfactant has a polymeric hydrophilic portion, as recited in claim 25.

Brown teaches that one or more other additives may be combined with the electrolyte composition such as reducing agents, grain refiners and other wetting agents, brightening agents and the like (col. 5, lines 26-32).

Like Brown, Kurze teaches electroplating tin (col. 2, lines 53-59). Kurze teaches that the use of polyalkylene glycol naphthyl-3-sulfopropyl diethers in tin electroplating baths surprisingly does not passivate the surface of the cathodes. The action

corresponds to that of blends of non-ionic and ionic surfactants but in addition bright deposits in a large range of current densities with good, up to very good, ductility are produced. With increased temperature and current density in high performance baths, the compounds are very stable. Further foaming occurs to only a very limited degree (col. 2, line 64 to col. 3, line 6).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the surfactant described by Brown with wherein the surfactant is a sulfopropylated anionic surfactant; and wherein the sulfopropylated anionic surfactant has a polymeric hydrophilic portion because the use of polyalkylene glycol naphthyl-3-sulfopropyl diethers in tin electroplating baths would not have passivated the surface of a cathode; produced bright deposits in a large range of current densities with good, up to very good, ductility; would have been very stable in high performance baths; and foaming would have occurred to only a very limited degree as taught by Kurze (col. 2, line 64 to col. 3, line 6).

c. Between approximately 1 and 2 grams of one or more polyethyleneglycol alkyl-3-sulfopropyl diethers per liter, as recited in claim 26.

Kurze teaches that the amount of the compounds to be used in electroplating baths are 0.01 to 20 g/l (col. 2, lines 53-59).

As to one or more polyethyleneglycol alkyl-3-sulfopropyl diethers, structural relationships may provide the requisite motivation or suggestion to modify known

compounds to obtain new compounds (MPEP § 2144.08(II)(A)(4)(c) and §2144.09).

III. Claims 27 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Brown et al.** (US Patent No. 6,322,686 B1) as applied to claims 21-23 and 29 above, and further in view of **Larson** (US Patent No. 6,982,191 B2).

Brown is as applied above and incorporated herein.

The method of Brown differs from the instant invention because Brown does not disclose the following:

- a. Wherein electroplating the tin comprises electroplating tin onto a semiconductor device, as recited in claim 27.
- b. Wherein electroplating tin onto the semiconductor device comprises electroplating tin bumps to connect a semiconductor die to packaging, as recited in claim 28.

Brown teaches that any substrate that can be electrolytically plated with metal is suitable for plating according to his invention. Suitable substrates include, but are not limited to, electronic components (col. 6, lines 35-44).

Larson teaches that in conventional flip-chip attachment, an array of conductive bumps such as solder balls is formed on the surface of a semiconductor die, the conductive bumps being used to mechanically and electrically connect the die to a higher-level packaging, such as a carrier substrate in the form of a printed circuit board. The formation of the solder balls may be carried out by a number of different methods.

For example, a composite solder material of tin and lead may be electrodeposited through a mask to produce a desired pattern of solder masses to form bumps, the solder material then being heated to reflow to form solder balls by surface tension (col. 1, lines 15-28).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroplating of the tin described by Brown with wherein electroplating the tin comprises electroplating tin onto a semiconductor device; and wherein electroplating tin onto the semiconductor device comprises electroplating tin bumps to connect a semiconductor die to packaging because an electronic component disclosed by Brown would have been a semiconductor die. In conventional flip-chip attachment, an array of conductive bumps such as solder balls is formed on the surface of a semiconductor die, the conductive bumps being used to mechanically and electrically connect the die to a higher-level packaging as taught by Larson (col. 1, lines 15-28).

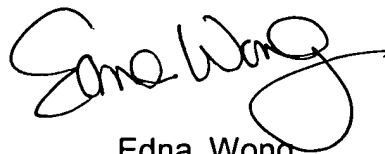
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



Art Unit: 1753

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

A handwritten signature in black ink, appearing to read "Edna Wong", with a large, stylized loop at the end.

Edna Wong  
Primary Examiner  
Art Unit 1753

EW  
February 8, 2007